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Alternating Gradient Synchrotron

Facility Environmental Monitoring Report

Calendar Year 2002

BROOKHAVEN NATIONAL LABORATORY

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Alternating Gradient Synchrotron

Facility Environmental Monitoring Report

Summary of Results

High levels of tritium continue to be detected in groundwater downgradient of the g-2/VQ12 Magnet area. Tritium concentrations up to 3,440,000 pCi/L were detected in samples collected in July 2002 from a monitoring well located approximately 150 feet downgradient of the activated soil shielding. Inspection of the impermeable cap that was installed over the VQ-12 Magnet area in December 1999 found it to be structurally sound. It is likely that the continued presence of high levels of tritium in groundwater is due to the release of residual tritium from the vadose zone following natural fluctuations in water table position.

Groundwater monitoring indicates that tritium concentrations downgradient of the former E-20 Catcher and former U-Line target areas continue to be well below the 20,000 pCi/L drinking water standard, indicating that the impermeable caps have been effective in preventing additional residual activation from entering the groundwater. Groundwater monitoring results for other soil activation areas such as the Booster Beam Stop, Building 914, Building 912, and the J-10 stop indicate only low to nondetectable levels of tritium.

The Facility Area Monitoring thermoluminescent dosimeter number 054-TLD1, at Bldg. 914 (near the new NSRL facility), showed an elevated dose above the sitewide quarterly average of 18 $\pm$ 4 mrem in the first and second quarters of calendar year 2002. The TLD measured an ambient dose of 62.4 and 84.5 mrem for the first and second quarters, respectively. The third quarter TLD had a dose of 13.3 mrem and the fourth quarter dose was 18.7 mrem. The elevated readings were attributed to the sky-shine phenomenon during the operation of the Booster and beam transfer operations in Bldg. 914.

There was one SPDES permit excursion for pH at Outfall 002 (HN). Upon investigation, the excursion was attributed to stormwater runoff from a construction site within the AGS/RHIC complex. The pH of the stormwater runoff was elevated due to its interaction with newly poured concrete and a crushed-concrete parking lot base. The pH returned to normal levels, 8.1 SU, when checked on December 23, as requested by NYSDEC.

Environmental Monitoring Program

As required by DOE Order 5400.1, BNL has established an environmental monitoring program at the Alternating Gradient Synchrotron (AGS) facility to evaluate potential impacts to environmental quality from its operation, and to demonstrate compliance with DOE requirements and applicable federal, state, and local laws and regulations.

Operations at the AGS facility have the potential to affect soil, surface water and groundwater quality. The primary environmental concern is beam line interaction with the AGS beam stops and targets. Secondary particles created in these areas may interact with the surrounding soil shielding. These interactions can result in the production of tritium and sodium-22, which can be leached out of the soils by rainwater if left unprotected. In addition, various routine cooling water and floor drain discharges from the AGS complex have the potential to affect surface water quality via discharge to the BNL sewage treatment plant. Additional discharges from once through cooling water systems, cooling towers, and stormwater have the potential to affect groundwater quality at recharge basins.

The environmental monitoring program for the AGS area is described in the BNL Environmental Monitoring Plan (BNL, 2000 and 2002). The monitoring programs results are summarized below.

Monitoring Results

Groundwater Program

Activated soils have been created near a number of AGS experimental areas as the result of secondary particles (primarily neutrons) produced at beam targets and beam stops. Radionuclides, such as tritium and sodium-22, have been produced by the interaction of secondary particles with the soils that surround these experimental areas. A number of engineered controls (i.e., impermeable caps, stormwater collection systems, and tunnel structures) are in place to prevent rainwater infiltration into the activated soils, and potential leaching and transport of tritium and sodium-22 to the groundwater. The activated soil shielding areas are currently monitored by more than 50 wells to verify the effectiveness of current operational and engineered controls. The locations of the AGS monitoring wells are shown on Figure 1.

Historical surface spills and discharges of solvents to cesspools and recharge basins near the AGS have contaminated soils and groundwater with volatile organic compounds (VOCs). VOC contamination is monitored under the ER program's OU III Central Areas (see the annual *BNL Site Environmental Report* for details on VOC groundwater contamination in the AGS area).

Groundwater, g-2 Experiment Area

Samples collected during 2002 from wells located approximately 150 feet downgradient of the VQ12 area indicate that tritium continues to be released to the groundwater. The highest tritium concentrations were measured in July 2002, when 3,440,000 pCi/L was detected in a sample from monitoring well 054-07, located immediately west of Building 912A. In the area east of Bldg. 912, tritium concentrations decreased from a maximum of 58,900 pCi/L (well 065-122) in April to 12,500 pCi/L (well 065-123) in October. Figure 1 shows the position of the g-2 tritium plume. The two segments of the plume are representative of two distinct periods of tritium release (also referred to as slug releases). The leading segment of tritium contamination was released in 1999 prior to the installation of the cap over the VQ12 area, whereas the second slug is related to tritium released in 2001–2002. As discussed below, the 2001–2002 release appears to be related to the flushing of residual tritium from the vadose zone following a significant rise in the local water table.

Inspections of the cap and review of its design have concluded that the cap over the VQ12 area has not failed and is properly positioned. The cap appears to be effective in preventing the infiltration of rainwater into the activated soil-shielding zone. The leading hypothesis at this time is that a natural rise in the water table may have released residual tritium from the unsaturated soil into the groundwater. It is believed that this tritium was mobilized to the soils close to the water table before the cap was put in place in December 1999.

Following the initial discovery of the plume in November 1999 and capping of the source area in December 1999, tritium concentrations in wells located immediately downgradient of the VQ12 source area declined significantly and remained low through September 2001 (Figure 2). However, higher than expected tritium concentrations were again detected in these monitoring wells in November 2001 and May–August 2002.

Water levels in the central BNL area in mid-2000 and mid-2001 were near the highest observed in 49 years of record by the U.S. Geological Survey. Once the cap was in place, the lack of additional rainwater infiltration essentially kept the tritium in the vadose zone from migrating into the groundwater until the significant rise in water table mobilized it. There appears to be good correlation between high tritium concentrations detected in monitoring wells immediately downgradient of VQ12, and the groundwater table elevation about one year prior to the sampling (Figure 3). The groundwater travel time from beneath the source to the monitoring wells is about one year.

Figure 4 uses the same data to develop another correlation analysis. In this figure, the tritium concentration in monitoring wells is plotted against the water table height one year before the groundwater sample event. This figure suggests that a threshold phenomenon is occurring. For example, when the water table height was above 45.5 ft above mean sea level (MSL), high concentrations of tritium were observed in monitoring wells one year later.

Because of the continued release of tritium from the VQ12 area, BNL and the regulatory agencies decided that additional monitoring data would be needed to better evaluate the vadose zone release hypothesis before finalizing the Engineering Evaluation/Cost Analysis (EE/CA), and submitting the Action Memorandum (BNL, 2003). In early 2003, BNL will collect additional groundwater samples using permanent and temporary wells, and BNL will also investigate other potential water pathways that could mobilize tritium from the vadose zone. These potential pathways include stormwater running into cable trenches that run close to the VQ12 soil activation area, perched zones in the subsurface soils, and nearby sheet piling that extends into the groundwater.

Groundwater, Former E-20 Catcher Area

In late 1999, tritium and sodium-22 were detected in wells approximately 100 feet downgradient of the former E-20 Catcher. The highest levels of tritium and sodium-22 were 5,800 pCi/L and 219 pCi/L, respectively. To further evaluate the extent of contamination, four Geoprobe wells were installed in January 2000. Tritium and sodium-22 levels in the temporary wells were found to exceed the drinking water standards, with concentrations of 40,400 pCi/L and 704 pCi/L, respectively. In April 2000, a temporary impermeable cap was installed over the E-20 Catcher soil activation area to prevent rainwater infiltration and the continued leaching of radionuclides out of the soils and into groundwater. A permanent cap was constructed by October 2000. During 2001 and 2002, all tritium concentrations were found to be below applicable drinking water standards. During 2002, the maximum observed tritium concentration was 774 pCi/L in well 064-80 (Table 4).

Groundwater, Former U-Line Target

Low levels of tritium are routinely detected in wells downgradient of the former U-Line target. The highest tritium concentration during 2002 was 7,450 pCi/L in well 054-129 located approximately 200 feet downgradient of the target area (Table 4).

Groundwater, Former U-Line Beam Stop

Following the detection of tritium at concentrations up to 71,600 pCi/L in temporary wells installed downgradient of the Former U-Line beam stop in March–April 2000, BNL installed a temporary impermeable cap over the U-Line beam stop soil activation area to prevent rainwater infiltration and the continued leaching of radionuclides out of the soils and into groundwater. By October 2000, a permanent cap was constructed over the U-Line stop area, and two additional permanent wells (054-168 and 054-169) were installed to provide improved long-term monitoring. During 2001–2002, tritium concentrations in downgradient wells were well below the drinking water standard. During 2002, the maximum observed tritium concentration was 5,650 pCi/L in downgradient well 054-168 (Table 4).

Groundwater, Building 912 Area

Other than tritium contamination that is traceable to several upgradient sources, groundwater surveillance data for 2002 do not indicate that appreciable levels of tritium are being released from potentially activated soils located beneath the experimental floor (Table 2). As noted above, the g-2 tritium plume has been tracked from the VQ-12 Magnet source, beneath a portion of Bldg. 912, to an area just southwest of the Waste Concentration Facility (WCF). Elevated levels of tritium from this plume have been detected in several downgradient wells (especially wells 065-121, 065-122, 065-123, and 065-124). Furthermore, low levels of tritium that are traceable to the Former U-Line Target area have been detected in downgradient well 055-32. In areas not impacted by the g-2 tritium plume, tritium was either nondetectable or was only observed at trace levels.

Groundwater, Booster Beam Stop Area

During 2002, tritium was detected in downgradient well 064-52 at a concentration of 445 pCi/L (Table 3). During 2001, tritium was detected in this same well, at 1,340 pCi/L. The low levels of tritium detected during 2001 and 2002 could be related to a short-term uncovering of activated soil shielding near the former Booster Beam Stop (northwestern section of the Booster) during construction of the tunnel leading from the Booster to the new NASA Space Radiation Laboratory (NSRL), formerly known as the Booster Applications Facility. This work, which began in September 1999 and was completed by October 1999, may have allowed rainwater to infiltrate the low-level activated soil shielding.[1]

Groundwater, Building 914 Transfer Area

During 2002, tritium was not detected in any of the samples collected from the three wells located downgradient of the 914 transfer area (Table 3).

Groundwater, J-10 Beam Stop Area

Low levels of tritium (up to 987 pCi/L) were detected in both samples from downgradient well 054-64 (Table 3). Prior to the beginning of beam-scraping activities at J-10 in December 1999, low levels of sodium-22 had been detected in this area, and trace levels of tritium were detected in 2001. It is likely that the trace levels of tritium and sodium-22 are related to historical low-level activation of soils along this section of the beam line.

Groundwater, NSRL Beam Stop Area

Prior to the start of NSRL operations, a shallow monitoring well was installed immediately downgradient of the facility's beam stop area (well AGS-44). The new well, and older well 054-08, will be used to verify the effectiveness of the cap placed over the NSRL tunnel and beam stop. Tritium was not detected in pre-operational samples collected from these wells.

Environmental Dosimeters

Environmental thermoluminescent dosimeters (TLDs) are used to measure direct penetrating radiation in the field. The environmental TLDs measure an ambient external dose to living organisms. Three TLDs in the vicinity of the AGS (074-TLD1, 074-TLD2, and 054-TLD1) are used to establish ambient dose rates (Table 5). These monitoring locations are shown on Figure 5. The 054-TLD1 in the vicinity of NSRL facility was sub-categorized as a Facility Area Monitoring (FAM) dosimeter, as it does not accurately represent environmental dose in that area and therefore biases the on-site average dose. The FAM dosimeters had been deployed in locations known to have radiological contamination and /or high probability to external radiation dose, such as from sky shine phenomenon.

The FAM dosimeter 054-TLD1 located at Bldg. 914, near the new NSRL facility, had 62.4 mrem dose rate for the first quarter and 84.5 mrem for the second quarter. The third and fourth quarter TLD showed a dose of 13.3 and 18.7 mrem, respectively. The high

[1] Before construction of the NSRL tunnel commenced, soil samples were collected by drilling through the tunnel wall near the Booster Beam Stop to verify that the tritium and sodium-22 levels were within acceptable limits for worker safety and environmental protection.

doses for the first and second quarters were investigated for potential source term and were attributed to skyshine phenomenon from Booster operations and beam transfer operations in Bldg. 914. The ambient sitewide dose for CY 2002 was similar to that measured at Bldg. 197 (074-TLD1) and Bldg. 907 (074-TLD2) and the natural background sources.

SPDES Monitoring

The State Pollution Discharge Elimination System (SPDES) permit authorizes discharges from the Sewage Treatment Plant (STP) to the Peconic River, and discharges of cooling water and stormwater to recharge basins. Sanitary wastes from AGS facilities are discharged to the BNL sanitary sewer system. Cooling tower blowdown from Bldg. 902 is also discharged to the sanitary sewer. The Bldg. 902 cooling tower discharge is monitored quarterly for flow, pH, and polypropylene glycol monobutyl ether, a heat transfer fluid (UCONN LB-170-X). In addition, a daily log of oil consumption must be maintained. Monitoring of the site sanitary system is performed at the treated effluent discharge to the Peconic River.

In addition, various cooling water, floor drain, and stormwater discharges from the AGS complex are monitored at five recharge basin outfalls (Figure 6). Outfall 002 (Basin HN) receives experimental cooling tower blowdown from Bldg. 912, and stormwater runoff. Outfall 003 (Basin HO) receives AGS noncontact cooling water discharged from the main magnet heat exchanger located in Bldg. 911. Outfall 006A (Basin HT-W) receives Linac noncontact cooling water, NSRL noncontact cooling water, cooling tower blowdown, and floor drain and stormwater runoff. Outfall 006B (Basin HT-E) receives Bldg. 919 cooling tower blowdown, noncontact cooling water, as well as floor drain and stormwater discharges. Finally, Outfall 012 (Recharge Basin HZ) receives stormwater discharges from buildings 197, 902, 905, and 941. Discharges to Outfall 012 started in October 2002. During 2002, these outfalls were monitored for flow and pH on a weekly basis, and oil and grease on a monthly basis. The outfalls were also monitored for volatile organic compounds and cooling tower treatment reagent residuals, as required for each outfall. In February 2002, aluminum was added to the quarterly monitoring requirements for Outfall 002.

During CY 2002 there was one SPDES permit excursion for pH at Outfall 002 (HN). Upon investigation, the excursion was attributed to stormwater runoff. On Friday, December 20, heavy rain (1.53 inches) resulted in significant runoff from developed portions of the site. At the radiological storage building construction site on Thompson Road, the pH of the runoff from newly poured concrete and a crushed-concrete parking lot base was measured at 10 SU. This runoff, combined with other runoff from nonconstruction areas within the AGS/RHIC complex, resulted in a pH of 9.4 SU measured at the outfall. NYSDEC did not require any mitigative actions when they were notified of the excursion, as required in BNL's SPDES permit. The pH returned to normal levels, 8.1 SU, when checked on December 23 as requested by NYSDEC.

The Environmental and Waste Management Services Division (EWMSD) held two Lessons Learned meetings regarding the excursion. Action items from the first meeting included trending the pH at the outfall, reviewing Plant Engineering (EP) flow models completed for the outfall, reviewing cooling tower treatment chemical additions, sampling the crushed-concrete parking lot base, reviewing erosion control at construction sites, and reviewing the Plant Engineering's ESH-500A and NEPA checklists for stormwater environmental impacts. At the second meeting, additional improvement were identified; these improvements included adding stormwater runoff to Plant Engineering's ESH 500-A form as a potential liquid effluent for review during EP projects. In addition, Plant Engineering personnel agreed to review their standard contract language regarding erosion control to ensure it states that contractors must adequately control stormwater discharges when using crushed-concrete paving base. Finally, EWMSD is requiring EP to perform more formal enforcement and application of erosion control measures, especially those that impact stormwater drainage systems. The excursion triggered EWMSD's Environmental Event Response procedure. All details regarding the excursion are documented on Environmental Event Response Documentation Form 02-03.

Environmental Surveillance Monitoring

Besides SPDES monitoring, all discharges are monitored quarterly for radionuclides, metals, volatile organic compounds, and water chemistry parameters as part of BNL's Environmental Surveillance Program.

Outfall 002 (HN)

During 2002, no radionuclides related to BNL operations were detected in the discharges to basin HN. Three of the eight gross alpha and beta analyses results were below the method detection limit (MDL). The maximum alpha concentration was 2.4 pCi/L, detected in April, whereas the maximum beta concentration was 3.5 pCi/L, detected in October. Tritium was not detected in any of the samples, and only naturally occurring gamma-emitting radionuclides were observed.

Although aluminum and iron have been detected above the NYSDEC effluent limit in the past, levels for both metals were well within the limits during 2002. These metals could be related to native sediment carried by stormwater runoff or corrosion products associated with the piping for the cooling system.

Low levels of trihalomethanes (< 3.1 µg/L) were sporadically detected in the discharges to Outfall 002. However, these compounds are common potable water disinfection by-products, and not attributable to AGS operations.

Outfall 003 (HO)

During 2002, no radionuclides related to Laboratory operations were detected in the discharges to Outfall HO. The majority of the gross alpha and beta concentrations were below the MDL. The maximum alpha concentration was 5.1 pCi/L (the highest of all AGS outfalls), whereas the maximum beta concentration was 3.0 pCi/L, both detected in

July. Tritium was not detected in any of the samples, and only naturally occurring gamma-emitting radionuclides were observed.

Analyses for metals and water chemistry parameters did not find any parameters above the MDL during either test on discharges from Outfall 003 throughout 2002. Low levels of trihalomethanes (< 2.0 µg/L) were sporadically detected in the discharges to Outfall 003.

Outfall 006A (HT-W)
During 2002, no radionuclides related to BNL operations were detected in the discharges to basin HT-W. Half of the gross alpha and beta concentrations were below the MDL. The maximum alpha concentration was 2.0 pCi/L, and the maximum beta concentration was 3.6 pCi/L, both detected in April. Tritium was not detected in any of the samples, and only naturally occurring gamma-emitting radionuclides were observed.

Elevated levels of metals are sporadically detected in the discharge to Outfall 006A, and aluminum, iron, and selenium were detected in January 2002. The maximum concentrations of these metals were 1.9 mg/L, 0.7 mg/L, and 22 µg/L, respectively. The iron and selenium concentrations were greater than the corresponding NYSDEC effluent limitations of 0.6 mg/L and 20 µg/L, respectively, but note that this sample was unfiltered. A filtered sample collected at the same time had lower concentrations, with the iron concentration less than the MDL. Elevated levels were due to natural corrosion products associated with the cooling system piping or native sediments carried by stormwater runoff. Low levels of trihalomethanes (< 2.3 µg/L) were detected sporadically in the AGS discharges to Outfalls 002, 003, 006A, and 006B.

Outfall 006B (HT-E)
During 2002, no radionuclides related to BNL operations were detected in the discharges to basin HT-E. The majority of the gross alpha and beta concentrations were below the MDL. The maximum alpha concentration was 4.2 pCi/L, and the maximum beta concentration was 5.3 pCi/L (the highest of all AGS outfalls), both detected in October. Tritium was not detected in any of the samples, and only naturally occurring gamma-emitting radionuclides were observed.

Although aluminum and iron have been detected above the NYSDEC effluent limit in the past, levels for both metals were well within the limits during 2002 sampling. Their presence could be related to native sediment carried by stormwater runoff or to corrosion products associated with the cooling system piping.

Low levels of trihalomethanes (< 4.7 µg/L) were detected sporadically in the AGS discharges to station HT-E. In addition, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, and naphthalene were detected in April at 1.1 µg/L, 0.6 µg/L, and 0.9 µg/L. The typical detection limit is 0.5 µg/L and the associated quality assurance trip blank did not detect these compounds. The trichlorobenzene compounds are associated with dielectric fluids, dye carriers, and heat transfer mediums. Naphthalene is associated with coal tar, crude oil, and wood preservatives. All concentrations are much less than the NYSDEC effluent standard of 5 µg/L.

Outfall 012 (HZ)
Discharge to the outfall began in late 2002. Therefore, there are no environmental surveillance data available for 2002. Monitoring requirements were added with the *2003 Environmental Monitoring Plan*, and include quarterly sampling for radionuclides, metals, volatile organic compounds, and water chemistry parameters.

Future Actions

The following actions are either in progress or need to be completed:

- Finalize an Engineering Evaluation/Cost Analysis for the g-2 tritium plume and submit it to the regulatory agencies by November 1, 2003. The Action Memorandum will be submitted by June 1, 2004.
- Continue quarterly monitoring of wells used to track the g-2 tritium plume.
- Continue semiannual monitoring of wells used to monitor the former E-20 Catcher, former U-line Target and Stop areas, Building 912, J-10 Stop, the 914 Transfer area, and the Booster Stop.
- In late 2001, BNL petitioned NYSDEC to modify the Laboratory's SPDES discharge permit. The changes were approved by NYSDEC, and a revised SPDES permit was received in February 2002. Total aluminum was added to the quarterly monitoring parameters for Outfall 002 (HN). Monitoring at Outfall 003 (HO), located behind the Central Steam Facility, was removed. Outfall 012, located west of the BLIP facility, was added to the list of SPDES-permitted outfalls. Although NYSDEC is not requiring monitoring at these outfalls, BNL will perform quarterly monitoring of the water discharges as part of the Environmental Surveillance Program.

References

BNL. 2000. *Brookhaven National Laboratory Environmental Monitoring Plan 2000*. BNL-52584. Brookhaven National Laboratory, Upton, NY. March 2000.

BNL. 2002. *Brookhaven National Laboratory Environmental Monitoring Plan CY2002 Update.* BNL-52584 (Update). Brookhaven National Laboratory, Upton, NY. January 2002.

BNL. 2003. *Work Plan, Characterization and Monitoring of the g-2 Tritium Plume Area – AOC-16T*. (January 24, 2003).

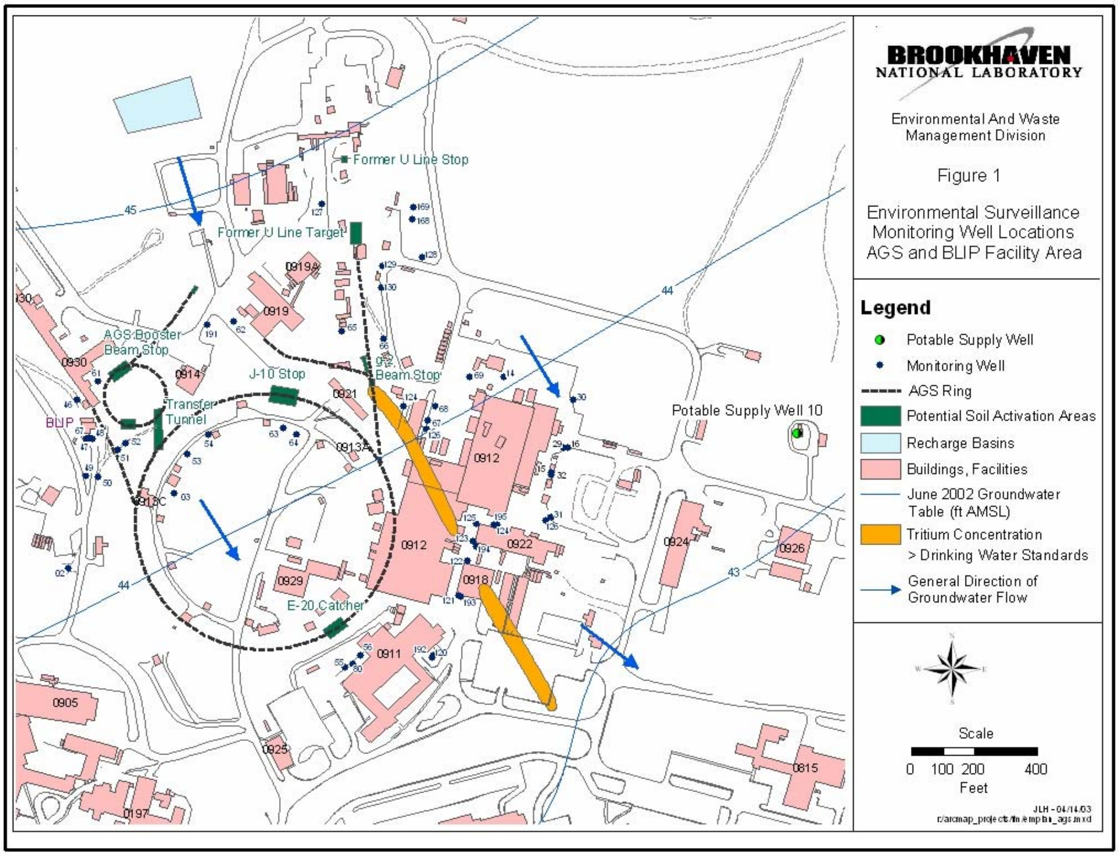

Figure 1. Locations of Groundwater Monitoring Wells in the AGS Area. Note that the g-2 tritium plume distribution is based upon a combination of the October 2002 sampling of permanent wells, temporary wells installed south of the Waste Concentration Facility in March 2003, and model predictions.

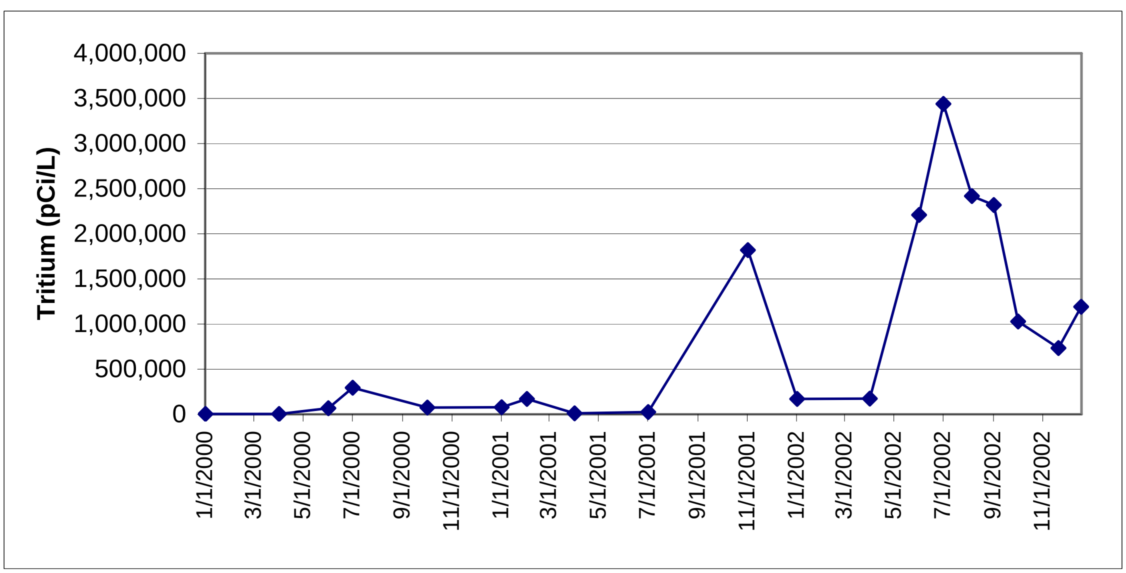

Figure 2. Maximum Tritium Concentrations Observed in Temporary and Permanent Monitoring Wells. These wells are approximately 150 feet downgradient of the VQ12 source area.

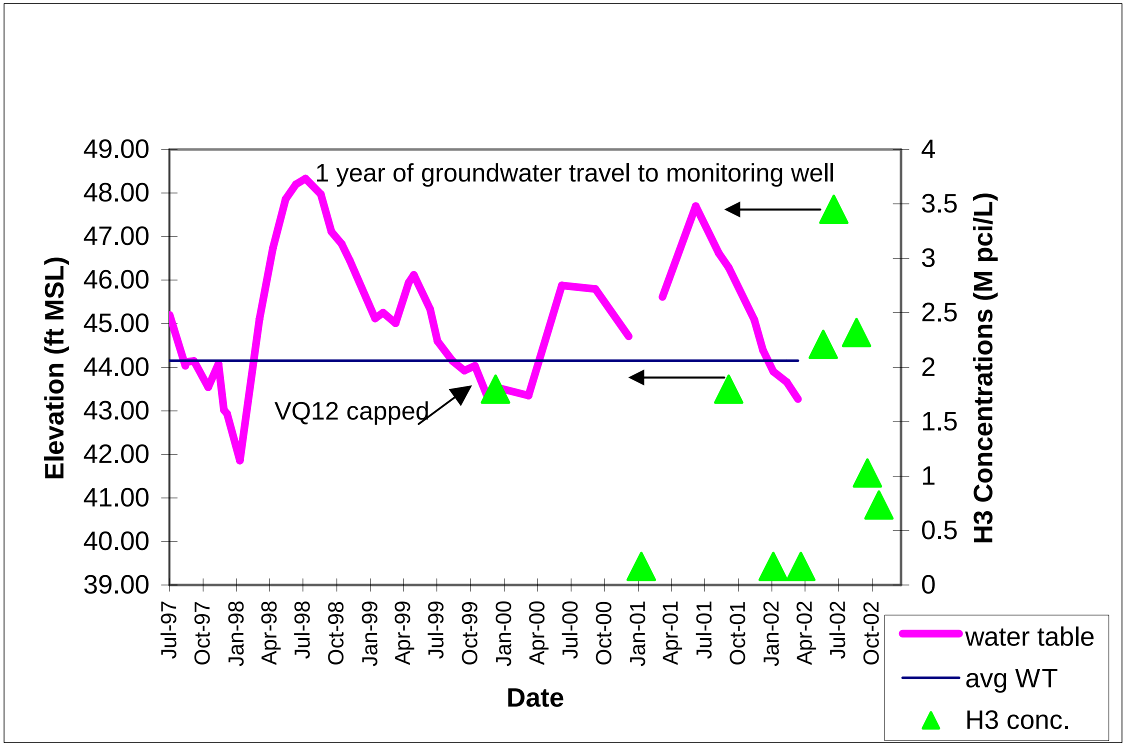

Figure 3. This figure illustrates the water table elevation in the g-2 area (left axis) and the tritium concentrations detected in monitoring wells with time (right axis). The arrows point to the water table elevation one year prior to the groundwater sample collection.

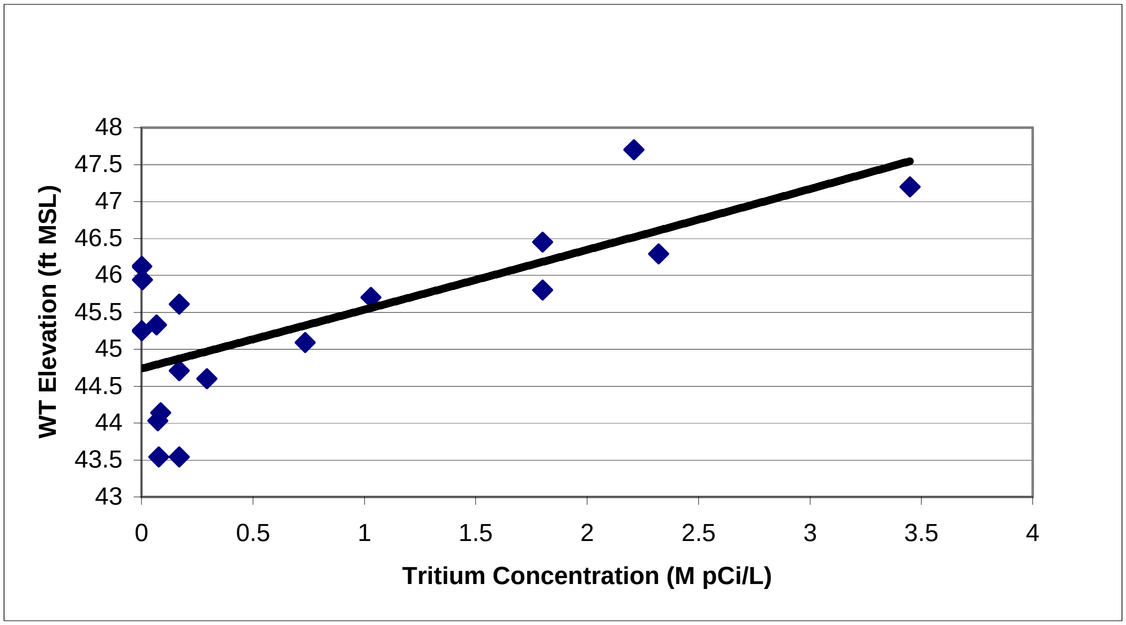

Figure 4. This figure illustrates the water table elevation in the g-2 area (left axis) and the tritium concentrations detected in downgradient monitoring wells one year later.

Figure 5. Locations of Environmental TLDs for the BNL Site.

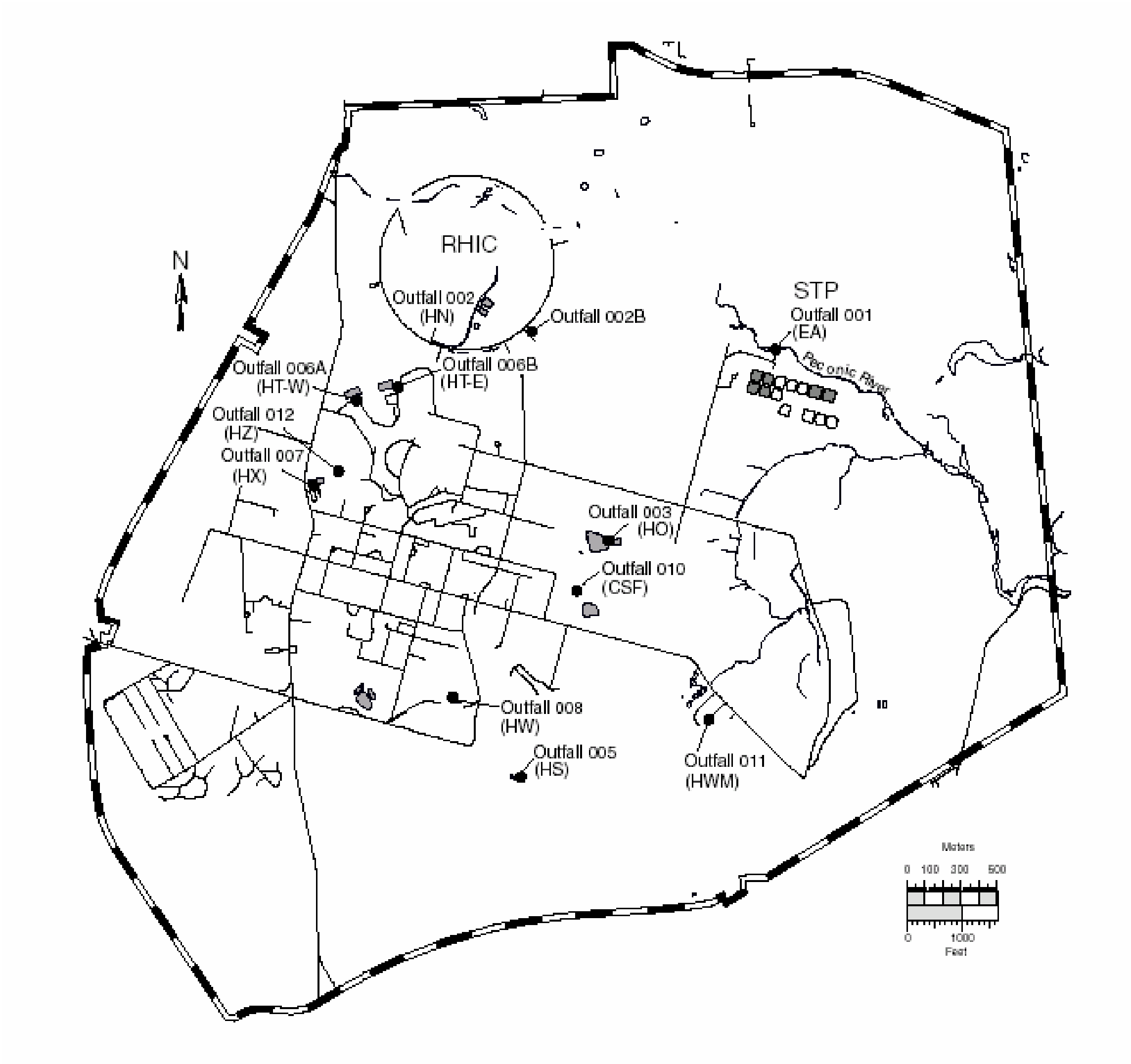

Figure 6. Locations of SPDES-Permitted Outfalls.

Table 1. g-2 Tritium Plume, Summary of Tritium and Sodium Results for CY 2002.

Well	Depth (bls)	Test	Jan. 10–23	April 17–18	June 11–12	July 9–11	Aug. 9	Sept. 5–6	Oct. 3–24	Nov. 20
			pCi/L							
West and South of Building 912A										
054-65[a]	18'–33'	H3	<316	<310	NS	<278	NS	NS	<359	NS
		Na-22	NA	ND		NA			NA	
054-124	25'–40'	H3	1,080 +/- 228	1,520 +/- 333	1,640 +/- 367	2,280 +/- 271	1,180 +/- 315	2,430 +/- 390	7,140 +/- 528	NS
		Na-22	NA	ND	NA	NA	NA	NA	NA	
054-07	30'–40'	H3	122,000 +/- 2,480	174,000 +/- 3,530	2,210,000 +/- 44,600	3,440,000 +/- 69,200	2,420,000 +/- 48,600	2,320,000 +/- 46,800	1,030,000 +/- 20,800	735,000 +/- 14,800
		Na-22	NA	46.1 +/- 4.4	NA	NA	NA	NA	257 +/- 20.6	NA
054-184	35'–45'	H3	171,000 +/- 3,470	30,100 +/- 1,020	1,870 +/- 367	2,770 +/- 305	2,700 +/- 388	2,080 +/- 378	847 +/-293	NS
		Na-22	NA	75.9 +/- 6.5	NA	NA	NA	NA	6.9 +/- 1.4	
054-185	29'–39'	H3	108,000 +/- 2,190	49,000 +/- 1,270	933 +/- 322	1,230 +/- 244	1,080 +/- 315	864 +/- 327	3,440 +/- 394	NS
		Na-22	NA	177 +/- 13	NA	NA	NA	NA	10.9 +/- 2.2	
064-95	38'–48' (GP well)	H3	NS	3,980 +/- 396[b]	2,570 +/- 394	3,150 +/- 372	4,000 +/- 437	3,810 +/- 452	3,800 +/- 415	NS
		Na-22		304 +/- 21	NA	NA	NA	NA	NA	
East of Building 912A										
054-126	25'–40'	H3	<316	<353	NS	<295	NS	<362	<359	NS
		Na-22	NA	ND		NA		NA	NA	
East of Building 912										
065-121	19'–34'	H3	956 +/- 316	1,550 +/- 233	NS	1,330 +/- 336	NS	NS	1,360 +/- 252	NS
		Na-22	NA	3.2 +/- 1.3		NA			NA	
065-193	50'–60'	H3	<316	<294	NS	<382	NS	NS	<297	NS
		Na-22	NA	ND		NA			NA	
065-321	27'–37'	H3	NI	NI	NI	1,340 +/- 253	NS	NS	990 +/- 236	NS
(MW-4)		Na-22				NA			NA	
065-322	27'–37'	H3	NI	NI	NI	1,210 +/- 249	NS	NS	1,480 +/- 259	NS
(MW-5)		Na-22				NA			NA	
065-323	25'–35'	H3	NI	NI	NI	2,250 +/- 300	NS	NS	990 +/- 235	NS
(MW-6)		Na-22				NA			NA	
065-324	23'–33'	H3	NI	NI	NI	1,590 +/- 263	NS	NS	572 +/- 213	NS
(MW-7)		Na-22				NA			NA	

Table 1. g-2 Tritium Plume, Summary of Tritium and Sodium Results for CY 2002 (continued).

Well	Depth	Test	Jan. 10–23	April 17–18	June 11–12	July 9–11	Aug. 9	Sept. 5–6	Oct. 3–24	Nov. 20
			pCi/L							
East of Building 912 (continued)										
065-122	19'–34'	H3	41,100 +/- 899	58,900 +/- 1,200	NS	8,750 +/- 475	NS	NS	1,650 +/- 266	NS
		Na-22	NA	5.1 +/- 1.2		NA			NA	
065-123	18'–33'	H3	807 +/- 217	1,420 +/- 231	NS	1,150 +/- 226	NS	NS	12,300 +/- 544	NS
		Na-22	NA	2.6 +/- 0.9		NA			NA	
065-194	45'–55'	H3	<316	<294	NS	<293	NS	NS	1,250 +/- 248	NS
		Na-22	NA	ND		NA			NA	
065-124	18'–33'	H3	<316	595 +/- 193	NS	3,350 +/- 377	NS	NS	1,530 +/- 256	NS
		Na-22	NA	ND		NA			NA	
065-125	18'–33'	H3	<316	1,900 +/- 246	NS	1,640 +/- 308	NS	NS	534 +/- 211	NS
		Na-22	NA	ND		NA			NA	
065-195	45'–55'	H3	<316	<294	NS	<382	NS	NS	356 +/- 208	NS
		Na-22	NA	ND		NA			NA	
065-126	18.5'–33. 5'	H3	<316	<294	NS	<382	NS	NS	<359	NS
		Na-22	NA	2.1 +/- 1.7		NA			NA	
055-31	45'–55'	H3	366 +/- 195	505 +/- 188	NS	580 +/- 303	NS	NS	1,170 +/- 340	NS
		Na-22	NA	2.6 +/- 0.9		NA			NA	
Southwest of Waste Concentration Facility										
065-02	55'–65'	H3	2,320 +/- 361	<294	NS	804 +/- 228	NS	NS	<359	NS
		Na-22	NA	3.9 +/- 1.5		NA			NA	
065-173	35'–45'	H3	<391	<294	NS	<295	NS	NS	<359	NS
		Na-22	NA	ND		NA			NA	

Notes:
Drinking water standard for tritium = 20,000 pCi/L; for sodium-22 = 400 pCi/L.
[a] Well located upgradient of VQ-12 Area.
[b] Well 064-95 was sampled on May 23, 2002
NA = Not analyzed for this radionuclide.
NI = Well not installed at this time.
NS = Well not sampled during this period.

Table 2. Alternating Gradient Synchrotron (Building 912) Summary of Tritium and Sodium-22 Results for CY 2002.

Location	Well	January	April–May	July	October–November
Upgradient	054-67	NS	H3 = <339	NS	H3 = <327
	054-68	NS	H3 = <339	NS	H3 = <327
	054-69	NS	H3 = <398	NS	H3 = 485 +/- 269
	055-14	NS	H3 = 533 +/- 259	NS	H3 = 772 +/- 288
Downgradient	055-15	NS	H3 = <398	NS	H3 = <331
	055-16	NS	H3 = <398	NS	H3 = <331
	055-29	NS	NS	NS	NS
	055-30	NS	H3 = <369	NS	H3 = <289
	055-31	H3 = 366 +/- 195	H3 = 505 +/- 188 Na-22 = 2.6 +/- 0.9	NS	H3 = 1,170 +/- 340
	055-32	NS	NS	NS	NS
	065-120	NS	H3 = 413 +/- 233	NS	H3 = 348 +/- 258
	065-121 [a]	H3 = 956 +/- 221	H3 = 1,550 +/- 233 Na-22 = 3.2 +/- 1.3	H3= 1,360 +/- 252	H3 = 1,360 +/- 252
	065-122 [a]	H3 = 41,100 +/- 899	H3 = 58,900 +/- 1,200 Na-22 = 5.1 +/- 1.2	H3= 8,750 +/- 475	H3 = 1,650 +/- 266
	065-123 [a]	H3 = 807 +/- 217	H3 = 1,420 +/- 231 Na-22 = 2.6 +/- 0.9	H3 = 1,150 +/- 226	H3 = 12,300 +/- 544
	065-124 [a]	H3 = <316	H3 = 585 +/- 193 Na-22 = ND	H3 = 3,350 +/- 377	H3 = 1,530 +/- 256
	065-125 [a]	H3 = <316	H3 = 1,900 +/- 246 Na-22 = ND	H3 = 1,640 +/- 308	H3 = 534 +/- 211
	065-126 [a]	H3 = <316	H3 = <294 Na-22 = 2.1 +/- 1.7	H3 = <382	H3 = <359
	065-192	NS	H3 = 441 +/- 235 Na-22 = ND	NS	H3 = 668 +/- 280
	065-193 [a]	H3 = <316	H3 = <294 Na-22 = ND	H3 = <382	H3 = <297
	065-194 [a]	H3 = <316	H3 = <294 Na-22 = ND	H3 = <293	H3 = 1,250 +/- 248
	065-195	H3 = <316	H3 = <294 Na-22 = ND	H3 = <382	H3 = 356 +/- 208
	065-321 [a]	NI	NI	H3 = 1,340 +/- 253	H3 = 990 +/- 236
	065-322 [a]	NI	NI	H3 = 1,210 +/- 249	H3 = 1,480 +/- 259
	065-323 [a]	NI	NI	H3 = 2,250 +/- 300	H3 = 990 +/- 255
	065-324 [a]	NI	NI	H3 = 1,590 +/- 263	H3 = 572 +/- 213

Notes:

[a] = Well used to monitor the g-2 tritium plume.
NA = Not analyzed for this radionuclide.
NI = Well not installed during this sample period.
NS = Well not sampled during this period.

Table 3. Booster Beam Stop, J-10 Beam Stop, and g-2 Beam Stop Tritium and Sodium-22 Results for CY 2002.

Location	Well	January	April–May	July	October–November
Building 914 (Transfer Line)	064-03	NS	H3 = <398	NS	H3 = <327
	064-53	NS	H3 = <398	NS	H3 = <327
	064-54	NS	H3 = <398	NS	H3 = <331
Booster AF	054-08	NS	NS	NS	NS
	AGS-44	NI	NI	NI	H3 = <318
Booster Beam Stop	064-51	NS	H3 = <311 [a]	NS	H3 = <336
	064-52	NS	H3 = <311 [a]	NS	H3 = 445 +/- 267
J-10 Beam Stop	054-62	NS	H3 = <398	NS	H3 = <311
	054-63	NS	H3 = <398	NS	H3 = <311
	054-64	NS	H3 = 987 +/- 276	NS	H3 = 545 +/- 235
g-2 Beam Stop	054-67	NS	H3 = <369	NS	H3 = <327
	054-68	NS	H3 = <369	NS	H3 = <327
	054-125	NS	H3 = <369	NS	H3 = <327

Notes:
Drinking water standard for tritium = 20,000 pCi/L; for sodium-22 = 400 pCi/L.
[a] Booster Beam Stop wells were monitored in June.
NA = Not analyzed for this radionuclide.
NS = Well not sampled during this period.

Table 4. Former U-Line Target, Beam Stop, and E-20 Catcher Areas' Tritium and Sodium-22 Results for CY 2002.

Location	Well	January	April–May	July	October–November
U-Line Target	054-127	NS	H3 = <398	NS	H3 = <318
	054-129	NS	H3 = 7,450 +/- 500	NS	H3 = 756 +/- 216
	054-130	NS	H3 = <398	NS	H3 = <289
	054-66	NS	H3 = <398	NS	H3 = <331
	054-69	NS	H3 = <398	NS	H3 = 485 +/- 267
U-Line Stop	054-128	NS	H3 = 866 +/- 271	NS	H3 = 778 +/- 213
	055-14	NS	H3 = 533 +/- 256	NS	H3 = 772 +/- 288
	054-168	NS	H3 = <398	NS	H3 = 5,650 +/- 382
	054-169	NS	H3 = <398	NS	H3 = <289
E-20 Beam Catcher	064-55	NS	H3 = <369	NS	H3 = <373
	064-56	NS	H3 = <369	NS	H3 = <327
	064-80	NS	H3 = 595 +/- 249	NS	H3 = 774 +/- 333

Notes:
Drinking water standard for tritium = 20,000 pCi/L; for sodium 22 = 400 pCi/L.
NA = Not analyzed for this radionuclide.
NS = Well not sampled during this period.

Table 5. Environmental TLD Results for CY 2002.

Location	TLD #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
		----------mrem----------			
Bldg. 197	074 –TLD1	22.1	19.8	15.9	21.0
Bldg. 907	074 –TLD2	22.3	17.3	15.1	17.9
Bldg. 914	054 –TLD1	62.4	84.5	13.3	18.7